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Rotating spoke phenomena in low pressure E × B discharges[1]

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The rotating spoke is azimuthal plasma non-uniformity which has been observed in a variety of low pressure cross-field discharges of cylindrical geometry [1-3]. The spoke can appear in different modes ranging from m=1 to higher order modes which propagate in the direction perpendicular to electric and magnetic fields with velocities of much lower than E×B velocity [2,3]. Although spoke phenomena is known for more than four decades, physical mechanism responsible for triggering of the spoke is still not understood. Recent studies of Hall thrusters and Penning-type magnetized plasma discharges demonstrated that the spoke is directly responsible for the enhancement of the electron cross-field transport in these devices [1,4]. A combination of time-resolving plasma measurements, including high speed imaging and probes suggest that for partially ionized magnetized plasma discharges, the spoke instability is triggered by ionization mechanism [4]. These experimental results are supported by recent particle-in-cell simulations. The advancement in understanding of the spoke mechanism enabled us to develop and demonstrate effective methods of spoke control, including mode, velocity and direction of the spoke, and spoke suppression [5]. Among practical implications of these results is the ability to develop more effective methods of plasma confinement and uniformity for magnetically-enhanced discharges and more efficient magnetized plasma thrusters. In collaboration with M. Griswold, L. Ellison, N. J. Fisch, K. Matyash, R. Schneider and A. Smolyakov.

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